PTILOTHAMNION SPELUNCARUM (COLLINS & HERV.) COMB. NOV. (CERAMIACEAE, RHODOPHYTA) FROM PUERTO RICO

David L. BALLANTINE[1] and Michael J. WYNNE[2]

[1] Department of Marine Sciences, University of Puerto Rico, Mayagüez, Puerto Rico 00681
[2] Department of Biology, University of Michigan, Ann Arbor, Michigan 48109

ABSTRACT — A new combination is proposed for plants previously referred to as *Spermothamnion speluncarum* (Collins & Herv.) M.Howe [= *Rhodochorton speluncarum* Collins & Herv.] (Ceramiaceae, Rhodophyta). This red algal species is transferred to *Ptilothamnion* on the basis of the following characteristics: the presence of three periaxial cells cut off by the fertile female axis; a hypogenous cell that is longer than the subapical cell; and the fact that the hypogenous cell cuts off opposite involucral filaments. *Ptilothamnion speluncarum* is reported from Puerto Rico for the first time.

RÉSUMÉ — Une nouvelle combinaison est proposée pour les algues rapportées précédemment à *Spermothamnion speluncarum* (Collins & Herv.) M.Howe [= *Rhodochorton speluncarum* Collins & Herv.] (Ceramiaceae, Rhodophyta). Cette espèce d'algue rouge est transférée dans le genre *Ptilothamnion* sur la base des caractères suivants: la présence de trois cellules périaxiales émises par l'axe femelle fertile; une cellule hypogyne plus longue que la cellule sous-apicale; et le fait que la cellule hypogyne émette des filaments involucraux opposés. *Ptilothamnion speluncarum* est signalée à Puerto Rico pour la première fois.

KEY WORDS: Ceramiaceae, marine algae, *Ptilothamnion speluncarum*, Rhodophyta, taxonomy.

INTRODUCTION

Rhodochorton speluncarum Collins & Herv. was described based on sterile material from intertidal collections in Bermuda (Collins & Hervey, 1917). Howe (1920, p. 578) later collected the plant from "near low-water mark" in the Bahamas. He described tetrasporangia and male structures and transferred the species to *Spermothamnion*. *Spermothamnion speluncarum* (Collins & Hervey) Howe has also been reported from Curaçao, Netherlands Antilles (Hoek, 1968; Hoek *et al.*, 1975), Mexico (Huerta & Garza, 1980; Huerta *et al.*, 1987; Sánchez, 1980; Martínez-Lozano & Guajardo, 1991) and Brazil in the western Atlantic (Joly, 1965) as well as from the Canary Islands in the eastern Atlantic (Børgesen, 1930). Both the Brazilian and Canary Island reports are based on tetrasporic material only.

Members of the Spermothamnieae are morphologically quite similar. They produce variously branched upright axes which are produced from basal creeping filaments. Genera within the Spermothamnieae are segregated on the basis of presence or absence of a pericarp, presence or absence of carposporophyte involucres, number of auxiliary cells, and number of periaxial cells in the fertile segment (Gordon, 1972). Huisman (1985) discussed an evolutionary scenario for the Spermothamnieae in which the tribe arose from a Sphondylothamnieae-like ancestor. Genera within the Spermothamnieae diverged along two lines on the basis of possessing one or two auxiliary cells and subsequent loss of inner and/or outer involucres. *Ptilothamnion* with its single auxiliary cell is thought to have arisen through loss of the inner involucre (Huisman, 1985). Thus, the generic assignment of any Spermothamnieae in the absence of female plants is tenuous. Gordon (1972) speculated that *Spermothamnion speluncarum* might belong to the genus *Ptilothamnion*. Based on collections containing female plants which have been attributed to *Spermothamnion speluncarum*, we are able to confirm Gordon's suggestion and propose the transfer of this species to *Ptilothamnion*.

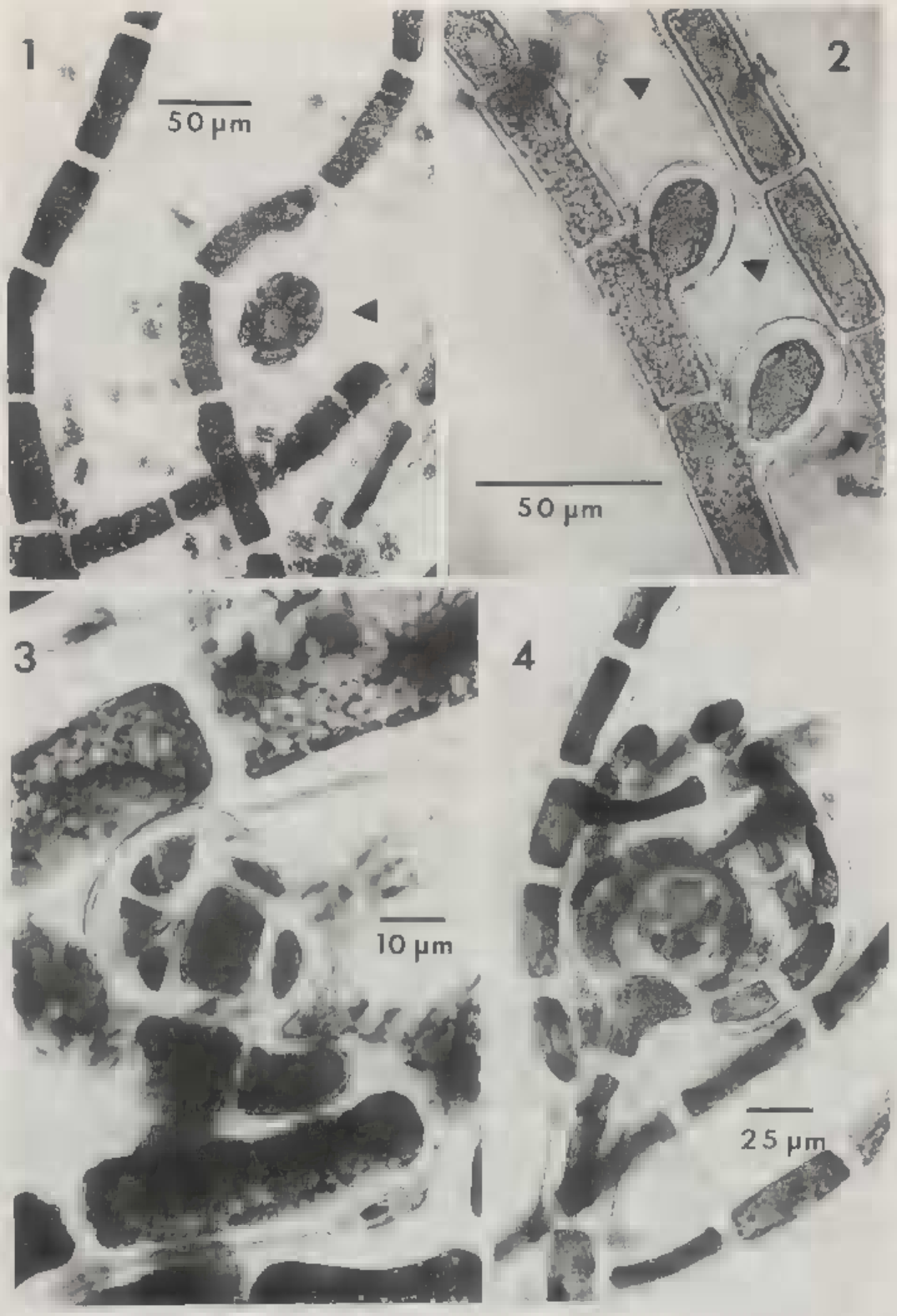
MATERIALS AND METHODS

Specimens were preserved in 10% formalin/seawater. Microscope slide preparations were mounted in 60% Karo® syrup on microscope slides. Photomicrographs using Kodak Pan Technical black and white film were taken through an Olympus BMAX light microscope. Camera lucida drawings were made using a Zeiss Universal Research Microscope with drawing tube. Nuclear staining followed the procedures of Goff & Coleman (1990) in which pieces of algae were placed in a small disposable petri dish with several drops of 0.5 µg/mL 4'-6 diamidino-2-phenolindole (DAPI) and microwaved at low power until the stain boiled. The stained algae was placed on a microscope slide which was then examined with an epifluourescent Olympus BMAX light microscope. Voucher slides stained with 1% acidified aniline blue have been deposited in MICH and MSM. Herbarium abbreviations follow Holmgren *et al.* (1990) and authority designations are according to Brummitt & Powell (1992).

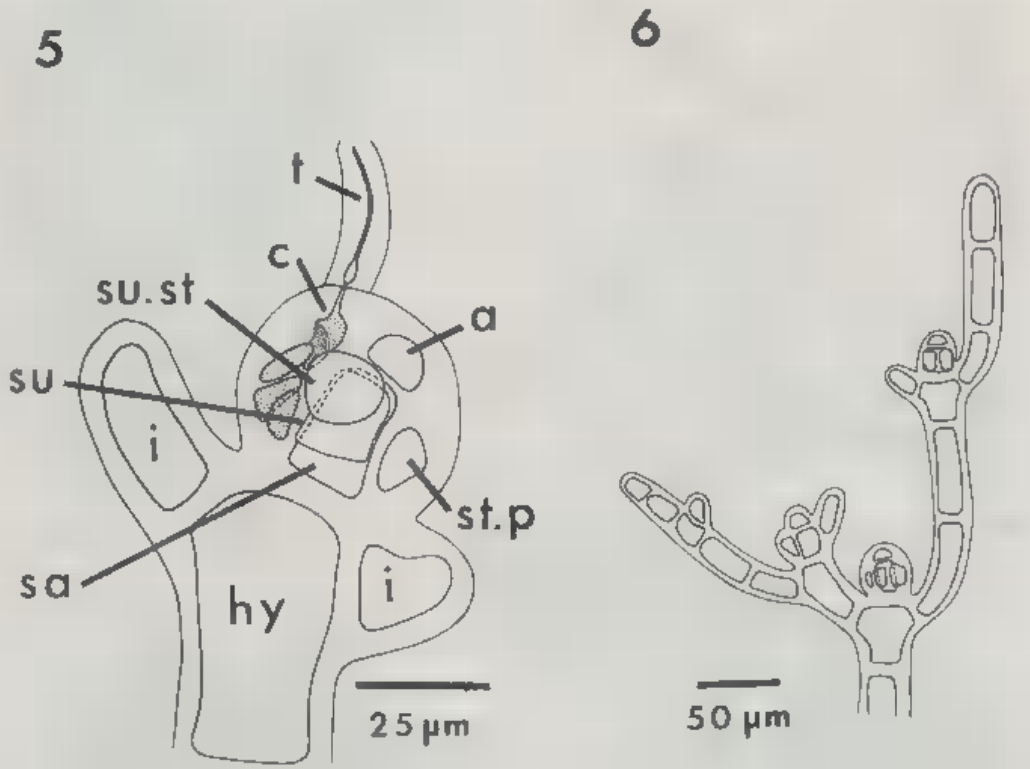
Material Examined: *D.L. Ballantine* 5238, on fishing line entangled among intertidal rocks, Corcega Beach, Rincon, Puerto Rico, 4.viii.1996; D.L.B. 5240, *Ibid*, 2.x.1996.

RESULTS

Algae were collected intertidally where they formed bright red conspicuous tufts to 1.5 cm high. Erect filaments develop from basal prostrate filaments, these producing unicellular rhizoids which are cut off from the middle of basal cells. Erect filaments measure the same diameter as the prostrate filaments, 27 to 35 µm in diameter. Branching is irregular, alternate or secund. Cells are multinucleate, each cell possessing 5 to 8 nuclei, and possess numerous closely packed chromatophores. Tetrasporangia are cut off laterally and are always sessile and solitary, measuring to 50 µm in longest dimension. They are



Figs 1-4. *Ptilothamnion speluncarum*. Fig. 1. Polysporangia (arrow heads) produced by axial filament. Fig. 2. Monosporangia (arrow heads) produced by consecutive axial cells in secund manner. Fig. 3. Fertile female axis supporting 4-celled carpogonial branch. Fig. 4. Young carposporophyte with surrounding involucral filaments. Figs 1-4 are all stained with aniline blue.



Figs 5-6. *Ptilothamnion speluncarum*. Fig. 5. Fertile female axis showing 2 of 3 periaxial cells (3rd periaxial cell is below the axial cell), sterile cell and the 4-celled carpogonial branch. Fig. 6. Female axis with several procarps. The two distal procarps have been produced from involucral filaments from the proximal procarp. a = apical cell; c = carpogonium; hy = hypogenous cell; i = involucral cell; sa = subapical cell; st.p = sterile periaxial cell; su = support cell; su.st = sterile cell on the supporting cell; t = trichogyne.

oblong to spherical in shape and are enclosed in a thick, to 5 µm, mucilaginous envelope. Polysporangia (Fig. 1) measure to 55 µm in length, and monosporangia (Fig. 2) measure to 40 µm in length. Polysporangia, monosporangia and tetrasporangia occur on the same axes. The fertile axes of female reproductive branches are three cells in length. Cells of the procarp are very tightly grouped together and could be discerned only after light squashing. The subapical or fertile axial cell cuts off three periaxial cells, one of which is the supporting cell which gives rise to the 4-celled carpogonial branch (Figs 3,5). The supporting cell also produces a single sterile cell. The entire procarp is always covered with a thick mucilaginous envelope. The hypogenous cell[1] which is always 2 to 4 times longer than the fertile axial cell, measures 32 to 50 µm in length. The fertile axial cell measures 12 to 15 µm in length. The hypogenous cell cuts off two opposite involucral filaments (Figs 4-6) which, if fertilization occurs, arch tightly around the developing cystocarp (Fig. 4). Occasionally the cell proximal to the hypogenous cell also produces a lateral which

1. The term hypogenous cell is used in the sense of Baldock and Womersley (1968). Gordon (1992) noted that this cell is distinct from the hypogynous cell.

contributes to the involucre. Short branchlets from this lateral also arch around the cystocarp (Fig. 4). Involucral filaments commonly continue growth if fertilization does not occur and these also produce procarps terminally (Fig. 6). The details of the procarp development indicate that the alga should be referred to *Ptilothamnion* and the following combination is proposed here:

***Ptilothamnion speluncarum* (Collins & Herv.) comb. nov.**

Basionym: *Rhodochorton speluncarum* Collins & Herv. 1917, The Algae of Bermuda, pp. 147-148.

Homotypic synonym: *Spermothamnion speluncarum* (Collins & Herv.) M.Howe 1920, *The Bahama Flora*, p. 578.

DISCUSSION

Maggs & Hommersand (1993) in their treatment of *Ptilothamnion* species from the British Isles, indicated that unicellular rhizoids arose in either a proximal or median position on cells of the prostrate axes. Kylin (1928) and Børgesen (1930) figured rhizoids issuing from the center of prostrate axial cells in *P. plumula* (Dillwyn) Thur. *in* LeJol. and *P. speluncarum* (as *Spermothamnion speluncarum*) respectively. Puerto Rico *P. speluncarum* also produces rhizoids from the middle of prostrate axial cells. Gordon (1972) separated *Ptilothamnion* from *Spermothamnion* on the basis of several criteria. In the former genus, the hypogenous cell is much longer than the subapical cell, the hypogenous cell produces two opposite involucral filaments, and the hypogenous cell is not incorporated into the fusion cell. In *Spermothamnion* the hypogenous cell is only slightly larger than the fertile axial cell and is incorporated into the fusion cell. *Spermothamnion* also does not produce involucral filaments (Gordon, 1972). An additional distinguishing feature is that in *Ptilothamnion*, the carposporophyte develops from a single auxiliary cell and in *Spermothamnion*, a pair of auxiliary cells each produce a carposporophyte (Gordon, 1972). Details of procarp structure and development indicate that the species under investigation clearly belongs in the genus *Ptilothamnion*.

To date there is only one previous record of *Ptilothamnion* in the western Atlantic, *Ptilothamnion occidentale* Searles. That species was described from offshore habitats in Georgia and South Carolina, southeast United States (Searles & Schneider, 1989). It is easily differentiated from *P. speluncarum* by its sparsely branched axes and by possessing tetrasporangia on lateral branchlets.

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